



Topic Modeling Classical Music: Introducing the song-chord matrix

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Music is Diverse



Styles within classical music



Musicologists dedicate careers to studying differences in styles



Can unsupervised learning be used to understand differences in harmonic styles between composers?

Differences in Harmony



Mozart: I - V - I



Chopin i - V - vi - ii - V7 - i

Data and Workflow

- Cross Composer Data Set
- 10 Composers, 100 Pieces Each
- Song-Chord Matrix
- NMF for Topic Modeling

Composers

- Bach
- Beethoven
- Brahms
- Dvorak
- Handel
- Haydn
- Mendelssohn
- Mozart
- Schubert
- Shostakovich

Implemented N-Grams and Word2Vec



Topic Modeling Produces Keys

- 24 “Topics”
- 12 Keys
- Major and Minor

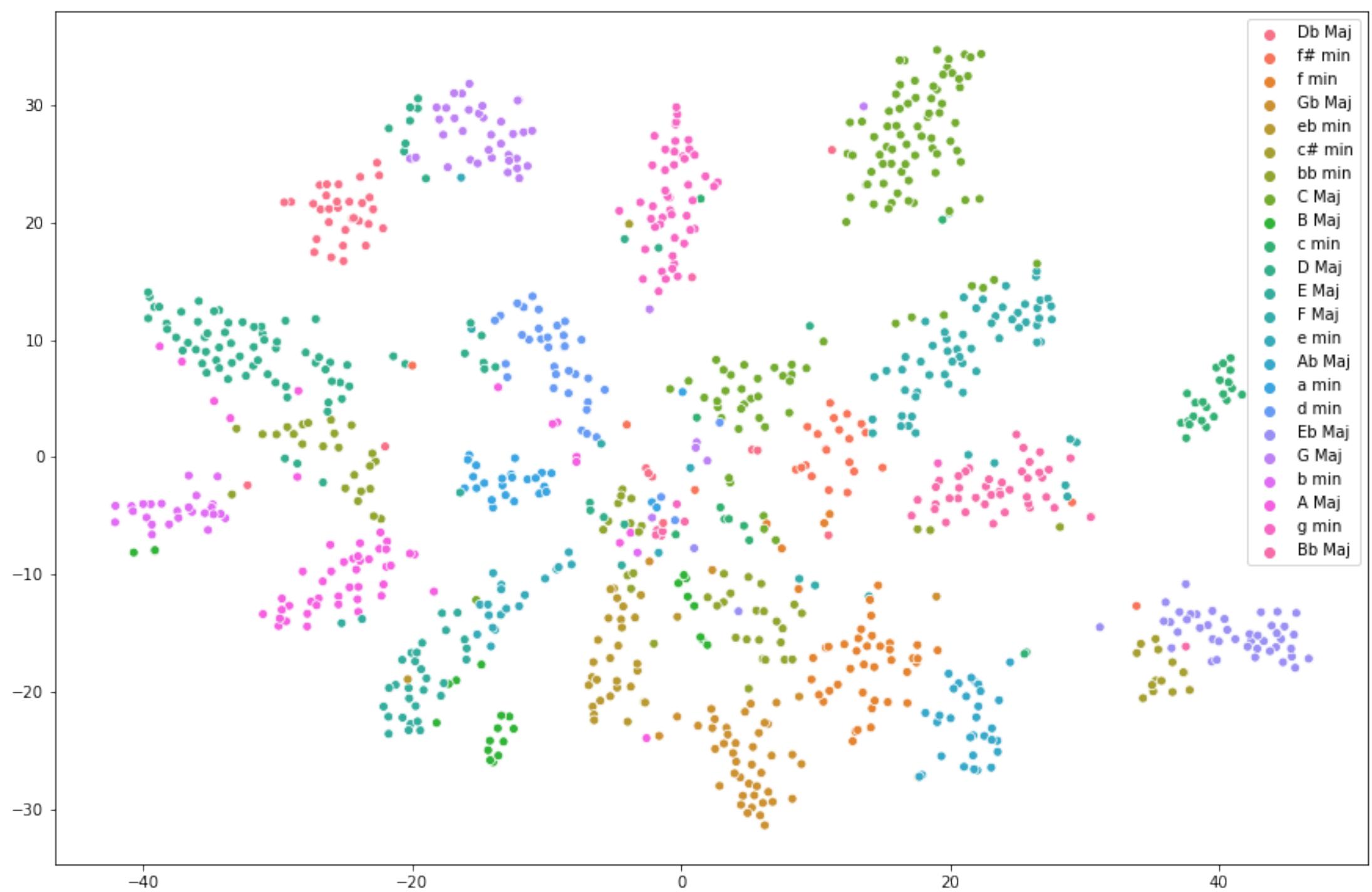
First 3 Topics

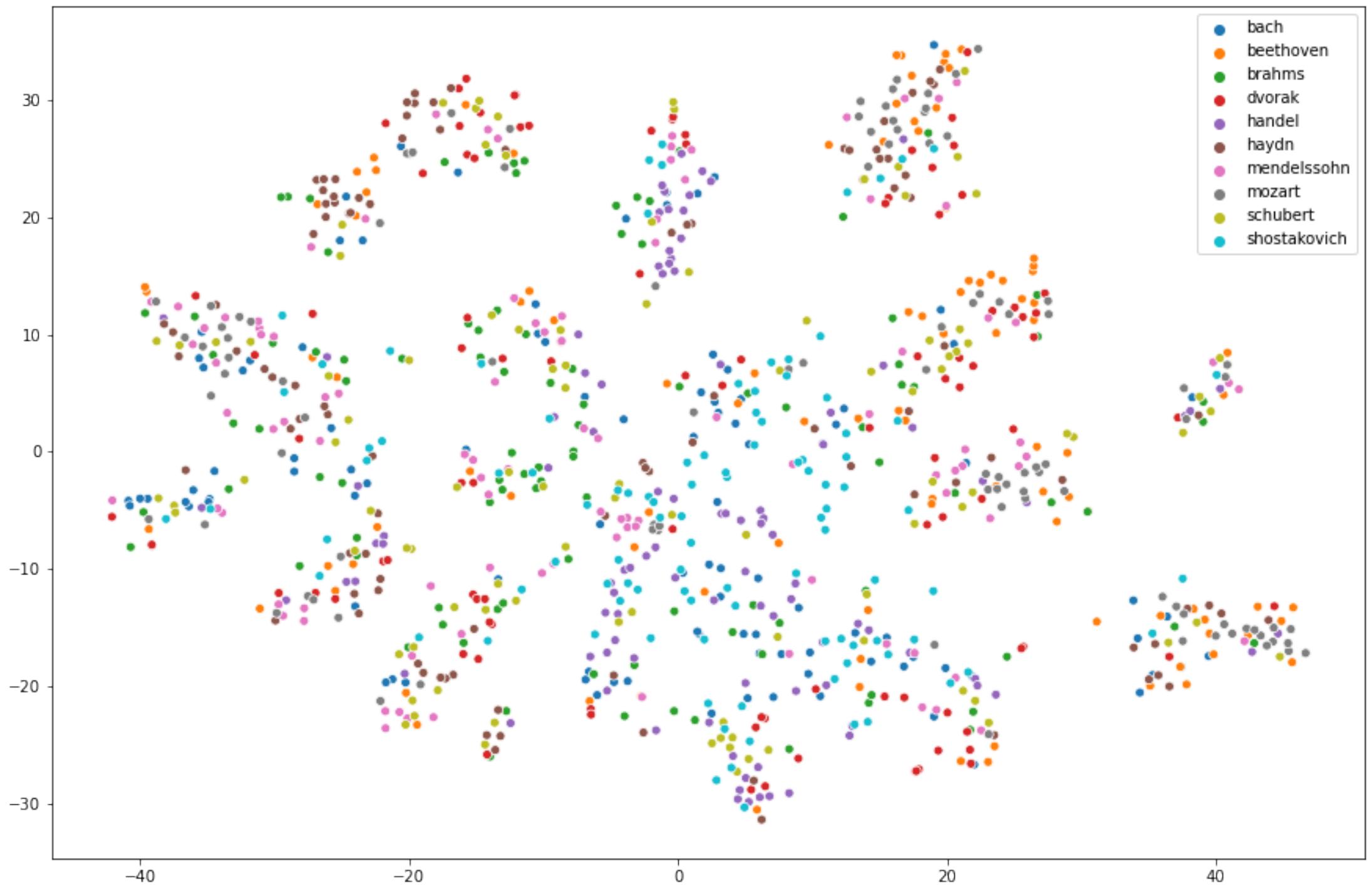
I - V - IV Chords

Topic 0: A_maj, E_maj_min7, D_maj

Topic 1: Eb_maj, Bb_maj_min7, Ab_maj

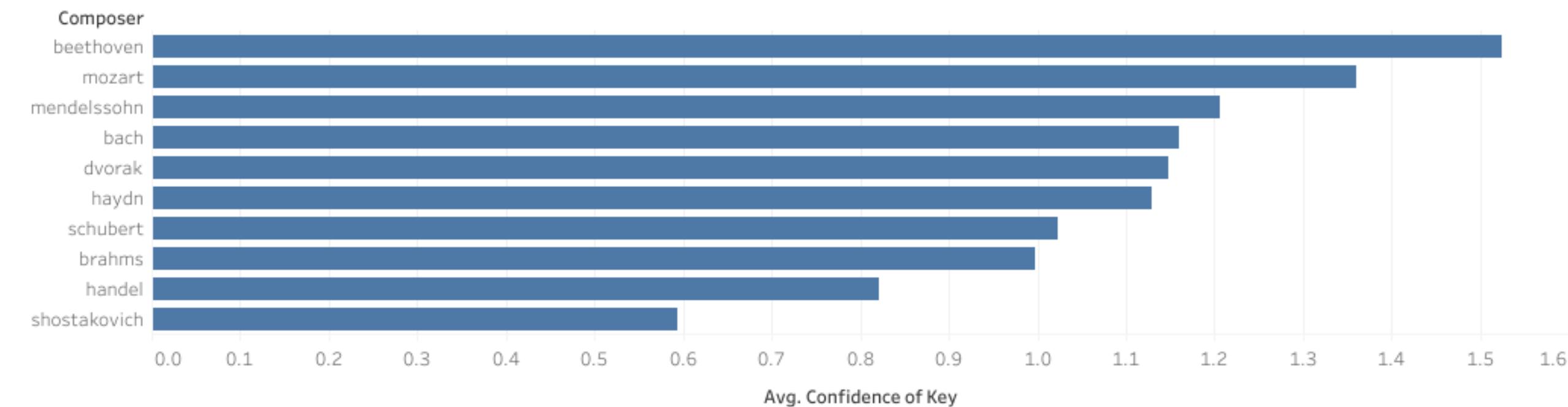
Topic 2: C_maj, F_maj, G_maj



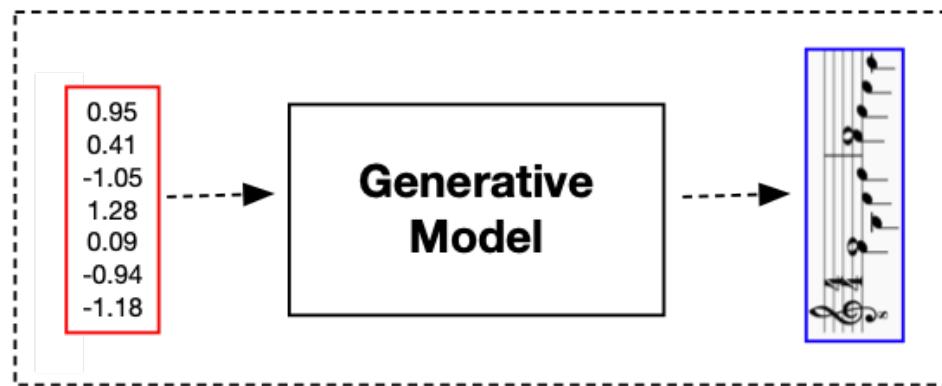


**Model's Confidence in What
Key a piece is in is a measure
for complexity of music**

Confidence of Key from Different Composers



Generating Music



Musical Examples

Beethoven versus Shostakovich

Measure: 1|1|0000

Time: 00:00:00.000

Repeat: 1



Score

Beethoven

Composer

Piano

A musical score for piano in 4/4 time. The top staff uses a treble clef and the bottom staff uses a bass clef. The score consists of five measures. Measure 1 starts with a quarter note in the treble clef staff followed by a half note in the bass clef staff. Measures 2 and 3 continue this pattern. Measure 4 features a half note in the treble clef staff and a quarter note in the bass clef staff. Measure 5 concludes with a half note in the treble clef staff and a quarter note in the bass clef staff.

6

A musical score for piano in 4/4 time. The top staff uses a treble clef and the bottom staff uses a bass clef. The score consists of six measures. Measure 6 begins with a half note in the treble clef staff and a quarter note in the bass clef staff. Measures 7 and 8 continue this pattern. Measure 9 features a half note in the treble clef staff and a quarter note in the bass clef staff. Measure 10 concludes with a half note in the treble clef staff and a quarter note in the bass clef staff.

12

A musical score for piano in 4/4 time. The top staff uses a treble clef and the bottom staff uses a bass clef. The score consists of six measures. Measure 12 begins with a half note in the treble clef staff and a quarter note in the bass clef staff. Measures 13 and 14 continue this pattern. Measure 15 features a half note in the treble clef staff and a quarter note in the bass clef staff. Measure 16 concludes with a half note in the treble clef staff and a quarter note in the bass clef staff.

Score

Shostakovich

Composer

Track 1

Musical score for Track 1, featuring four staves of music for two voices. The top staff is in G major (Treble clef) and the bottom staff is in C major (Bass clef). The music consists of measures 1 through 11. Measure 11 contains a measure repeat sign, indicating a repeat of the previous measure. The score includes various musical elements such as quarter notes, eighth notes, sixteenth notes, and rests, along with dynamic markings like forte and piano.

Layer 1

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SELECTION TOOL: Click an object to select it; Drag an object to move it; Double-click an object to go to its associated editing tool

Digital audio workstation interface showing a multi-track session. The session is titled "Shostakovich" and is set to Measure 1|1|0000. The tracks are labeled 2, 7, 8, 9, and 10. The tracks show complex musical patterns with multiple voices and dynamic changes. The interface includes playback controls at the top, such as play, stop, and transport buttons.

Takeaways



Music can be analyzed using digital signal processing



Patterns can be found in harmony and used to generate new music



Want to look at other musical features and other musical styles

Thank You!

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